Lummi Nation Silver Reef Casino Mitigation Project

Year 10 (2011) Monitoring Report

USACE Reference: 1999-4-01575

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Section 1—Project Overview

(1) **Permit:** Lummi Nation Silver Reef Casino Mitigation Project; U.S. Army Corps of Engineers Reference Number: 1999-4-01575, dated April 4, 2001.

(2) **Monitoring:** Year 10 salinity and hydrology monitoring was conducted on December 21, 2010 and January 7, 2011 by Lummi Nation Natural Resources Department staff members (LNR) Frank Lawrence III and Monika Lange; invasive species were surveyed and mapped by Monika Lange (LNR) and Stephanie Smith (Otak) on June 2, 2011; and vegetation monitoring was conducted on July 26 and 27, 2011 by Otak (Stephanie Smith and Suzanne Anderson) and LNR (Frank Lawrence III and Monika Lange) staff.

(3) **Project Purpose and Mitigation:** The Silver Reef Hotel, Casino, and Spa and associated parking facilities were constructed in 2001/2002 on the Lummi Indian Reservation, Whatcom County, Washington, at the southeast corner of the intersection of Haxton Way and Slater Road. The project resulted in filling 10.7 acres of degraded palustrine emergent wetland (reed canarygrass dominated). To compensate for wetland impacts, approximately 17.1 acres of upland grassland were graded to allow passive restoration of saltmarsh conditions, and establish a mosaic of high saltmarsh, low saltmarsh, and mudflat habitats. The mitigation site is hydrologically connected to Lummi Bay by a brackish slough via culverts and tide-gates (see Figures 4.1 and 4.2 in Section 4, and Figures in Appendix A).

(4) **Location:** The mitigation site is located on the Lummi Indian Reservation, adjacent to the dike access road, southwest of the intersection of Kwina Road and Hillaire Road, Section 14, Township 38 North, Range 1 East, at Latitude North 48.7897, Longitude West -122.6608 (see Figures 4.1 and 4.2 in Section 4). The north boundary of the mitigation area is delimited by a berm, and the east and south boundaries are defined by the slough. *Directions:* Take Exit 260 from I-5; head west on Slater Road. Turn south (left) on Haxton Way; continue to Kwina Road and turn west (right). Continue on Kwina Road to the intersection with Hillaire Road. Continue straight (west/southwest) (Kwina Road becomes an unpaved dike access road) for approximately 0.6 miles to the mitigation site, which is on the east (left) side of the road.

(5) **Completion Date:** Construction of the mitigation site was completed in August 2001.

(6) **Performance Standards Achievement:** As of July 2011, the majority of the Year 10 Performance Standards were being satisfied.

(7) **Maintenance Activities:** Because the mitigation site achieved performance standards for non-native invasive species in Year 9 (2010), no maintenance activities were undertaken during 2011.

(8) **Recommendations:** Based on Year 10 (2011) monitoring and wetland delineation results (see separate delineation report, Otak, 2011), the mitigation site is achieving the overall goals of the mitigation plan, and the restored estuarine habitat is providing significant uplift of habitat and other functions over those provided by either the impacted wetlands or the mitigation site prior to installation of the mitigation plan. On that basis, we recommend that the permitting agencies release the site as completed.

Permit Requirements for Monitoring

Permit Conditions require monitoring of the mitigation site for ten years, and 2011 is Year 10. The document: *Lummi Nation Casino Project: Wetland Compensation Site As-built Report and Monitoring Plan* (Sheldon & Associates, 2001) constitutes the approved monitoring plan. The Performance Standards listed below are quoted from the monitoring plan.

Performance Standards

The mitigation area was designed to be colonized by salt-tolerant species without any plantings onsite. Due to the large number of variables that influence the establishment of the plants, it was not possible to accurately predict colonization rates, species composition, or species diversity of the wetland. Consequently, the following five parameters are being used as measures of success of the compensation design. Comments *in Italics* were added to the original text as explanations.

Salinity

Salinity, as measured in the water column in inundated areas, will be greater than 5 ppt (*mistakenly identified as the minimum necessary to establish and maintain salt-tolerant vegetation*) in all portions of the site that are regularly inundated (below mean higher high water). It is expected that salinity values will exist as a gradient across the site; higher near the tide gates, lower as one approaches the upper reaches of the high marsh. *(Subsequent investigation has shown that 0.5 ppt salinity –not 5.0 ppt– is the conventional minimum necessary to establish and maintain salt-tolerant vegetation - see discussion of estuarine salinity concentrations in Section 3*).

Hydrologic Regime

A tidal hydrologic regime will be established such that there will be three broad, open channel connections between the site and adjacent tidal slough. The entire compensation site will be subject to tidal inundation at least periodically through a yearly tidal cycle in order to provide the hydroperiod and salinity necessary to create saltmarsh conditions throughout. A minimum of 60% of the site will be subject to regular twice-daily inundation.

Cover Type

Excluding the upper portion of the transitional zone from wetland to upland along the north boundary (about 0.5 acre), by the end of the tenth year following construction, the following ranges are expected for cover types:

- High marsh: 30-40% of compensation site (*5.1 to 6.8 acres of the 17.1 acre site*)
- Low marsh: 25-40% of compensation site (*4.3 to 6.8 acres of the 17.1 acre site*)
- Transitional mud flats: 15-35% of compensation site (*2.6 to 6.0 acres of the 17.1 acre site*)
- Mud flats: 5-15% of compensation site (*0.9 to 2.6 acres of the 17.1 acre site*)

Vegetation Species Presence and Extent

Excluding the upper portion of the transitional zone from wetland to upland along the north boundary (about 0.5 acre) the following conditions are expected by Year 10:

- 70% of the site will be vegetated with native salt-tolerant species (*approximately 11.9 acres of the 17.1 acre site*) - the remainder of the site is expected to be mud flats.
- Non-salt-tolerant species will not exceed 10% cover in either high or low saltmarsh areas.

- Invasive species including spartina, reed canarygrass, Scot's broom, and Himalayan blackberry will not exceed 10% total cover in the compensation site.

Wildlife Use

Based on visual assessment during monitoring trips, it is expected that the site will be used by: fish; juvenile crab and other commercial shellfish species; resident and migratory waterfowl; shorebirds; and other birds such as killdeer, heron, and gulls.

Table 2.1 Achievement of Year 10 (2011) Performance Standards

Monitoring Parameter	Performance Standards	Achieved
Salinity	Salinity will be greater than 5 ppt in all portions of the site that are regularly inundated (below mean higher high water)	No[a]
Hydrologic Regime	• Three channel connections between the mitigation site and the slough • Periodic inundation of the entire mitigation site • A minimum of 60% of the site will be subject to regular twice-daily inundation	Yes Yes Yes
Cover Type	• High Marsh: 30-40% of mitigation site (*5.1-6.8 acres*)	High Marsh: 5.9 acres - Yes
	• Low Marsh: 25-40% of mitigation site (*4.3-6.8 acres*)	Low Marsh: 4.4 acres - Yes
	• Transitional Mud Flats: 15-35% of mitigation site (*2.6-6.0* acres)	Vegetated Mud Flat: 1.1 acres – No[b]
	• Mud Flats: 5-15% of mitigation site (*0.9-2.6* acres)	Mud Flat: 3.9 acres – No[b]
Vegetation Species Presence & Extent	• Native salt-tolerant species on 70% of the site • Less than 10% cover by salt-sensitive species in high and low salt marsh areas • Less than 10% cover by non-native invasive species	Yes Yes Yes
Wildlife	Presence of fish; commercial shellfish species; resident and migratory waterfowl; shorebirds; and other birds	Yes

[a] The Performance Standard of 5.0 ppt salinity was achieved on the majority of the mitigation site in the summer. Salinity concentrations on most of the remainder of the site were greater than 0.5 ppt, which is within the conventional limits of estuarine salinity – see Section 3 and Figure 2 in Appendix A for details.

[b] The combined total of vegetated and unvegetated (which is largely covered by filamentous green algae) mud flat of 5.0 acres satisfies the Performance Standard for the 17.1 acre mitigation area.

Monitoring Parameters

This section includes summaries of the results of Year 10 monitoring parameters including: salinity; hydrology; vegetation community mapping (cover types); vegetation species presence, extent, relative abundance and salt-tolerance; and non-native invasive species. In addition, there is a summary of bird and wildlife observations.

Monitoring Methods

Monitoring methods and protocols are included in Appendix C.

References

References are listed in Appendix E.

Results

Monitoring results are summarized below; data tables and other details are located in Appendix D.

Salinity

Salinity was measured in winter 2011 (January 7, 2011) (see Figure 1 in Appendix A). Salinity measurements were taken primarily around the perimeter of the mitigation site, near the limits of inundation that day, where salinity concentrations would be expected to be minimal. In addition, the month prior to the measurements (December 2010) had 42 percent greater than average total precipitation, and nearly one inch of rain (0.83) fell the day before the measurements were taken (January 6, 2011), and over one-half of an inch of rain (0.63) fell during the day when measurements were made (Utah State University Climate Center, 2011; Western Regional Climate Center, 2011). The resultant volume of surface water runoff (both from the area to the north of the mitigation site as well as from the slough) would be expected to dilute salinity concentrations on the mitigation site. Despite this, the majority of the January 2011 salinity measurements exceeded 0.5 parts per thousand (ppt) (salinity measurements around the perimeter of the site ranged from 0.14 to 0.94 ppt). For comparison, salinity measurements taken last summer (June 18 and July 13, 2010) across the entire mitigation area ranged from 0.22 to 28.03 ppt (see Figure 2 in Appendix A). As expected, the general pattern is for the highest salinity concentrations to be located along the slough and created channels, with concentrations decreasing as the distance from the channels and elevations increase. The lowest salinity concentrations (less than 0.5 ppt) were generally located in the northeast corner of the site. For reference, salinity concentrations measured immediately outside and inside of the tidegates were 26.31 ppt and 25.7 ppt (respectively) on July 13, 2010. The Performance Standard of 5.0 ppt salinity was achieved on the majority of the mitigation site in summer 2010.

The salinity Performance Standard in the monitoring plan stipulates that 5.0 ppt salinity "*is the minimum necessary to establish and maintain saltmarsh vegetation*" and that salinity should be greater than 5.0 ppt for the portions of the site that are regularly inundated (Sheldon & Associates, 2001). Many of the salinity concentrations measured in the northern-most portion of the site were less than 5.0

ppt in 2010 and 2011. However, the 5.0 ppt salinity Performance Standard is significantly higher than the conventional salinity concentration limit of 0.5 ppt for estuarine habitat and salt-tolerant plant communities. Both federal (NOAA: Thayer et al., 2005; US EPA: Gibson et al., 2000; and US Fish and Wildlife Service: Cowardin et al., 1979) and state (Washington State Department of Natural Resources: Dethier, 1990; and Washington State Department of Ecology: Hruby, 2004) sources define estuarine communities as having salinity concentrations greater than or equal to 0.5 ppt. Most salinity classification systems are based on the *Venice System for the Classification of Marine Waters According to Salinity* (Battaglia, 1959), which defines Mixohaline (estuarine) salinity as ranging from ±30.0 to ±0.5 $^{0}/_{00.}$ The Venice System uses the outmoded symbol “ $^{0}/_{00}$ ” which designates one-tenth of a percent. In other words, 100 % = 1,000 $^{0}/_{00}$; with 0.5% = 5.0 ppt and 0.5 $^{0}/_{00}$ = 0.5 ppt. The federal Cowardin classification system (Cowardin et al., 1979, page 8) specifies: “*The Estuarine System extends (1) upstream and landward to where ocean-derived salts measure less than 0.5 $^{0}/_{00}$ during the period of average annual low flow…*” In addition, Washington Administrative Code [173-22-030 (11)(a)(ii)] specifies: “ *"Salt tolerant vegetation" means vegetation which is tolerant of interstitial soil salinities greater than or equal to 0.5 parts per thousand*”. It is likely that the 5.0 ppt salinity Performance Standard in the monitoring plan was the result of a mistaken interpretation of the outmoded *0.5 $^{0}/_{00}$* , which should have been interpreted as 0.5 ppt.

The 2010 and 2011 salinity measurements mirror the vegetation communities that were mapped onsite in 2010 and 2011 (see Figure 4 in Appendix A) – salinity measurements that were less than 0.5 ppt appear to be located either inside of, or proximal to, plant communities that were mapped as salt-sensitive wetlands. The majority of the salinity measurements between 0.5 and 5.0 ppt appear to be correlated with high saltmarsh communities (see definition below).

Therefore, on the basis that federal and state authorities define estuarine systems as having salinity greater than or equal to 0.5 ppt, and high saltmarsh plant communities are established on the mitigation site in areas where salinity concentrations measured between 0.5 and 5.0 ppt, it is reasonable to conclude that the salinity concentrations onsite are sufficient to achieve the mitigation goal of establishing and maintaining salt-tolerant vegetation.

Hydroperiod

The three required channel connections from the mitigation site to the slough were created when the site was constructed in 2001, and they are now well established (see Figures 1 through 6 in Appendix A). Water depths were measured in December 2010 and January 2011 (although water depths were only measured around the perimeter of the mitigation area), and the extent of inundation was mapped (see Figures 1 and 3 in Appendix A). Figure 3 shows that nearly the entire mitigation site was inundated in December 2010. The map of vegetation communities (see Figure 4 in Appendix A) and the wetland delineation report (Otak, 2011) demonstrate that approximately 18.1 acres of the approximately 18.7 acre site have sufficient hydroperiod for either hydrophytic vegetation or mud flats to become established; and that approximately 15.3 acres (or approximately 89 percent of the 17.1 acre mitigation area) is inundated frequently enough to establish high saltmarsh, low saltmarsh, or mud flats (with and without vegetation). These results indicate that the site is satisfying the hydrologic regime Performance Standards for periodic complete inundation, and for a minimum of 60 percent of the site to be subject to twice-daily inundation.

Vegetation Cover Types

The location and extent of the various vegetation communities that are established on the mitigation site were mapped in August 2010, July 2011, and during the wetland delineation conducted in June 2011 (Otak, 2011) – see Figure 4 in Appendix A. Based on salt-tolerance (see Table 3.2 below) and the delineation results, eight vegetation communities/habitats were characterized by the dominant species:

Mud Flat: (see Photos 15, 16, 28, 32, and 33 in Appendix B)

- areas without macrophytic vegetation – includes many areas with filamentous green algae.

Vegetated Mud Flat: (see Photo 20 in Appendix B)

- areas dominated by the aquatic species widgeongrass (*Ruppia maritima*).

Low Marsh (alkali bulrush/pickleweed community): (see Photos 28, 29, and 30 in Appendix B)

- alkali bulrush (*Scirpus maritimus*)
- pickleweed (*Salicornia viginica*)
- salt-grass (*Distichlis spicata*) (subdominant)

High Marsh (Baltic rush/Pacific silverweed community): (see Photos 30 and 31 in Appendix B)

- Baltic rush (*Juncus balticus*)
- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)

High Marsh (Pacific silverweed/creeping bentgrass community): (see Photo 19 in Appendix B)

- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)
- creeping bentgrass (*Agrostis stolonifera*)
- Baltic rush (*Juncus balticus*) (subdominant)

High Marsh (mixed Baltic rush/Pacific silverweed community): (see Photo 18 in Appendix B)

- Baltic rush (*Juncus balticus*)
- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)
- Lyngby's sedge (*Carex lyngbyei*) (subdominant)
- salt-grass (*Distichlis spicata*) (subdominant)
- creeping bentgrass (*Agrostis stolonifera*) (subdominant)

Non-tidal Wetland Area: (see Photo 7 in Appendix B)

- delineated wetland areas dominated by hydrophytic, but salt-sensitive, herbaceous species, with some willow (*Salix* sp.) and alders (*Alnus rubra*) along the northern boundary of the site.

Uplands: (see Photo 9 in Appendix B)

- delineated non-wetland areas, dominated by upland species

The location and extent of the vegetation communities/habitats is primarily determined by elevation and proximity to the slough and channels (see Figure 4 in Appendix A). As designed, the three channels consist of mud flat (much of which is covered by filamentous green algae) and vegetated mud flat which is dominated by widgeongrass.

The low saltmarsh community is located in a band along the channels and slough – the width of the community is determined by topography. High saltmarsh communities are located above the low saltmarsh community. The Baltic rush/Pacific silverweed community is the most common high saltmarsh community, and it is located in a band around the site. The Pacific silverweed/creeping bentgrass high saltmarsh community is located along the north side of the mitigation area, in a narrow, discontinuous band above the Baltic rush/Pacific silverweed high saltmarsh community. The mixed Baltic rush/Pacific silverweed high saltmarsh community is located along the south/southeast side of the mitigation area, in a band above the Baltic rush/Pacific silverweed high saltmarsh community. The salt-sensitive wetland areas are located at higher elevations around the outer perimeter of the site (mostly on the north and east sides), and upland areas are located where elevation is highest.

Coverage: The combined total of the three high saltmarsh communities is approximately 5.92 acres which is within the Year 10 Performance Standard target range of 30-40 percent of the 17.1 acre mitigation plan (5.1 to 6.8 acres). The low saltmarsh community covers approximately 4.39 acres, which is within the Year 10 Performance Standard target range of 25-40 percent of the 17.1 acre mitigation plan (4.3 to 6.8 acres). Mud flat (with and without vegetation) covers approximately 5.03 acres, which is within the Year 10 Performance Standard combined target range for mud flats and transitional mud flats of 5-35 percent of the 17.1 acre mitigation plan (0.9 to 6.0 acres). Of that total, there were 1.13 acres of vegetated mud flat (dominated by widgeongrass), which is less than the Year 10 Performance Standard target range of 15-35 percent of the 17.1 acre mitigation plan (2.6 to 6.0 acres). However much of the area designated as unvegetated mud flat is covered by filamentous green algae, which was not considered to be macrophytic vegetation for the purposes of wetland delineation (Otak, 2011). There is a total of 2.78 acres of wetland that is dominated by salt-sensitive plant species. There is also a total of 0.57 acres of upland, which is slightly greater than the target of 0.5 acres of upland for the 17.1 acre mitigation site.

Vegetation Species Presence and Extent

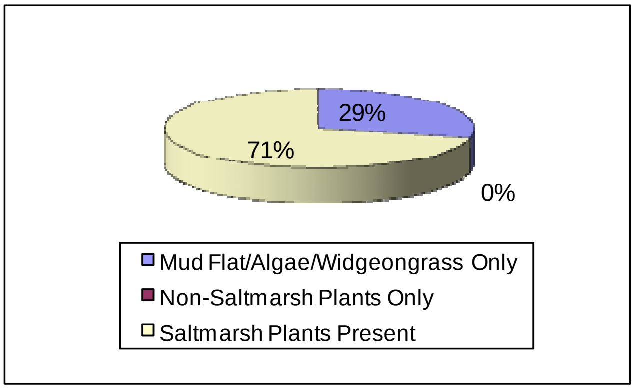
Table 3.1 below lists the most frequently observed plant species on the mitigation site - these six species were noted in more than 10 percent of the subplots in 2011. The majority of the species are salt-tolerant. Refer to Figure 5 in Appendix A for plot locations, and to Tables D2 and D3 in Appendix D for complete sub-plot data.

Table 3.1 Plant Species Occurring in at least 10% of Sub-Plots in 2011.

Vascular Plant Species		Salt Tolerance*	% of Sub-Plots Present
Agrostis stolonifera	creeping bentgrass	high	46.4
Juncus balticus	Baltic rush	high	33.6
Potentilla anserina (*Argentina egedii*)	Pacific silverweed	medium	28.8
Scirpus maritimus (*Schoenoplectus maritimus*)	alkali bulrush	high	27.2
Distichlis spicata	saltgrass	high	13.6
Vicia spp.	vetch	unknown	13.6
Other			
Algae		high	29.6
Mud Flat		NA	40.8

***** Salt tolerance from Hutchinson (1991), Hruby (2004), and USDA Plants Database (2011).

Figure 3.1 Percent of 2011 Sub-Plots With Various Cover Types.



As indicated by Figure 3.1 above, salt-tolerant species and estuarine habitats now dominate the mitigation site. Salt-tolerant plants were present in 71 percent of the sub-plots (89 of 125), and 29 percent (36 of 125) of the sub-plots were mud flats (with or without algae and/or widgeongrass). None of the 125 sub-plots had only salt-sensitive plant species. Plot data collected over the past ten years reflects an increasing frequency of occurrence of salt-tolerant species (see Table D1 in Appendix D).

Relative Abundance As useful as the resultant information is, the sub-plot vegetation sampling method is not without its short-comings (see Appendix C for details of the vegetation sampling methodology). Because the 25 permanent large plots (5 square-meters each) are sub-sampled in 625 square centimeter sub-plots (25 cm by 25 cm), and the 5 sub-plots per large plot are randomly selected, some species are over- or under-represented, or are missed altogether during the annual monitoring events. For example, despite its relatively common occurrence in the high saltmarsh community, Lyngbye's sedge (*Carex lyngbyei*) was present in only 3 of the 125 subplots in 2011. Table 3.2 below lists the plant species observed onsite, their degree of salt tolerance, and their relative abundance onsite. Relative abundance is a qualitative assessment of the frequency of occurrence and cover of individual species on the mitigation site as a whole, based on plot data augmented by observations made in the field. As is the general pattern for estuarine habitats, the non-tidal habitats on the mitigation site have a larger number of species than either the low or high saltmarsh communities.

Table 3.2 Salt Tolerance and Relative Abundance of Plant Species Observed in 2011.

		Salt Tolerance*	Relative Abundance**
Low Salt Marsh Species			
Atriplex patula	spear saltbush	high	rare
Cotula coronopifolia	common brass buttons	high	rare
Cuscuta salina	salt marsh dodder	high	rare
Distichlis spicata	saltgrass	high	abundant
Ruppia maritima	widgeon grass	medium	abundant
Salicornia virginica	pickleweed	high	common
Scirpus maritimus (*Schoenoplectus maritimus*)	alkali bulrush	high	abundant
Spergularia salina	saltmarsh sandspurry	high	rare
Triglochin maritima	seaside arrow-grass	high	uncommon
High Salt Marsh Species			
Aster subspicatus (*Symphyotrichum subspicatum*)	Douglas aster	high	uncommon
Agrostis stolonifera	creeping bentgrass	high	abundant
Carex lyngbyei	Lyngbye’s sedge	medium	common
Deschampsia cespitosa	tufted hairgrass	medium	common
Eleocharis palustris	creeping spikerush	medium	uncommon
Juncus balticus	Baltic rush	high	abundant
Juncus bufonius	toad rush	medium	uncommon
Potentilla anserina (*Argentina egedii*)	Pacific silverweed	medium	abundant
Scirpus americanus	American threesquare	medium	common
Salt-Tolerant Species			
Bromus mollis (*Bromus hordeaceus*)	soft brome	medium	uncommon
Dactylis glomerata	orchardgrass	medium	uncommon
Festuca arundinacea (*Schedonorus phoenix*)	tall fescue	medium	uncommon
Salt-Sensitive Species			
Agropyron repens (*Elytrigia repens*)	quackgrass	low	common
Alnus rubra	red alder	none	uncommon
Alopecurus pratensis	meadow foxtail	low	rare
Epilobium ciliatum	Watson's willowherb	unknown	uncommon
Equisetum arvense	field horsetail	none	uncommon
Holcus lanatus	velvet grass	none	common
Juncus effusus	soft rush	low	uncommon
Phleum pratense	common Timothy	low	uncommon
Plantago major	broadleaf plantain	low	uncommon
Poa annua	annual bluegrass	none	uncommon
Poa pratensis	Kentucky bluegrass	low	uncommon
Rumex crispus	curly dock	low	uncommon
Salix lucida ssp. *lasiandra*	Pacific willow	low	uncommon
Salix sitchensis	Sitka willow	none	uncommon
Scirpus tabernaemontani (*Schoenoplectus tabernaemontani*)	softstem bulrush	low	rare
Spiraea douglasii	spirea	none	rare
Trifolium pratense	red clover	low	uncommon
Trifolium repens	white clover	low	uncommon
Typha latifolia	cattail	low	rare
Veronica americana	American brooklime	none	rare
Vicia sp.	vetch	unknown	uncommon

***** Salt tolerance from Hutchinson (1991), Hruby (2004), and USDA Plants Database (2011).

****** Overall prevalence onsite assessed qualitatively - while some species are locally common, they are relatively uncommon on the mitigation site as a whole.

Table 3.2 Salt Tolerance and Relative Abundance of Plant Species Observed in 2011 continued.

		Salt Tolerance*	Relative Abundance**
Non-seed Plants			
Moss		none	uncommon
Algae	filamentous green algae	high	abundant
Algae	red algae	high	rare
Non-native invasive species			
Cirsium arvense	Canada thistle	unknown	uncommon
Lactuca sp.	prickly lettuce	unknown	uncommon
Phalaris arundinacea	reed canarygrass	medium	uncommon
Rubus armeniacus	Himalayan blackberry	unknown	uncommon
Sonchus sp.	sow-thistle	unknown	uncommon
Taraxacum officinale	dandelion	none	uncommon
Tanacetum vulgare	common tansy	unknown	uncommon

***** Salt tolerance from Hutchinson (1991), Hruby (2004), and USDA Plants Database (2011).
****** Overall prevalence onsite assessed qualitatively

Non-native Invasive Species

Reed canarygrass (RCG) (*Phalaris arundinacea*) is the predominant non-native invasive species on the mitigation site – there is only very limited presence of Himalayan blackberry (*Rubus armeniacus*). RCG is confined to patches located around the perimeter of the mitigation site where elevations are slightly higher - particularly along the eastern and north-central portions of the site (see Figure 6 in Appendix A). The boundaries of the invasive patches were surveyed, and the resultant square footage of invasive cover was adjusted to reflect the percent coverage by invasive species in each patch. Percent cover by invasive species in the individual patches varied from 5 percent to 100 percent, with 52 percent average cover (see Appendix C for Methods). The 2011 survey indicated that there was only 0.58 acres (3.4 percent) of cover by non-native invasive species on the 17.1 mitigation site, which is well below the Year 10 Performance Standard of 10 percent.

Photopoints

Photographs are included in Appendix B. In addition to overview photos (Photos 1 and 2), photos were taken at each of the 25 vegetation plots along the 6 transects (Photos 3 through 27) (see Figure 5 in Appendix A for plot locations). Photos of the various vegetation communities are included at the end of Appendix B (Photos 28 through 33).

Birds and Wildlife

The mosaic of vegetation communities onsite provides a range of wildlife habitats. See Table D4 in Appendix D for detailed listing of species observed onsite. Birds are the most frequently observed and reported animals – numerous species of waterfowl, shore birds, wading birds, songbirds, and birds of prey were observed on or over the mitigation site in 2011 including:

- birds of prey species including: Northern Harrier, Red-tailed Hawk, Vulture, Barn Owl (dead), and Bald Eagle;
- waterfowl species such as Mallard and Canada Goose; and

- other bird species including: Yellowlegs, Long-billed Dowitcher, Pectoral Sandpiper, Great Blue Heron, Belted Kingfisher, Marsh Wren, Red-winged Blackbird, Killdeer, Willow Flycatcher, Common Yellowthroat, Crow, Raven, and various Swallow and Gull species (see Photo 33 in Appendix B).

Some of the indicators of wildlife use of the mitigation site observed in 2011 include:
- coyotes sighted, and scat prevalent within the mitigation site;
- deer tracks and bedding areas prevalent within the mitigation site;
- river otter tracks and scat within the mitigation site;
- field mice (dead) observed;
- numerous beetles and spiders were observed on land, and invertebrates, such as water boatmen, amphipods, and shrimp, were observed in the water; and
- Sticklebacks observed.

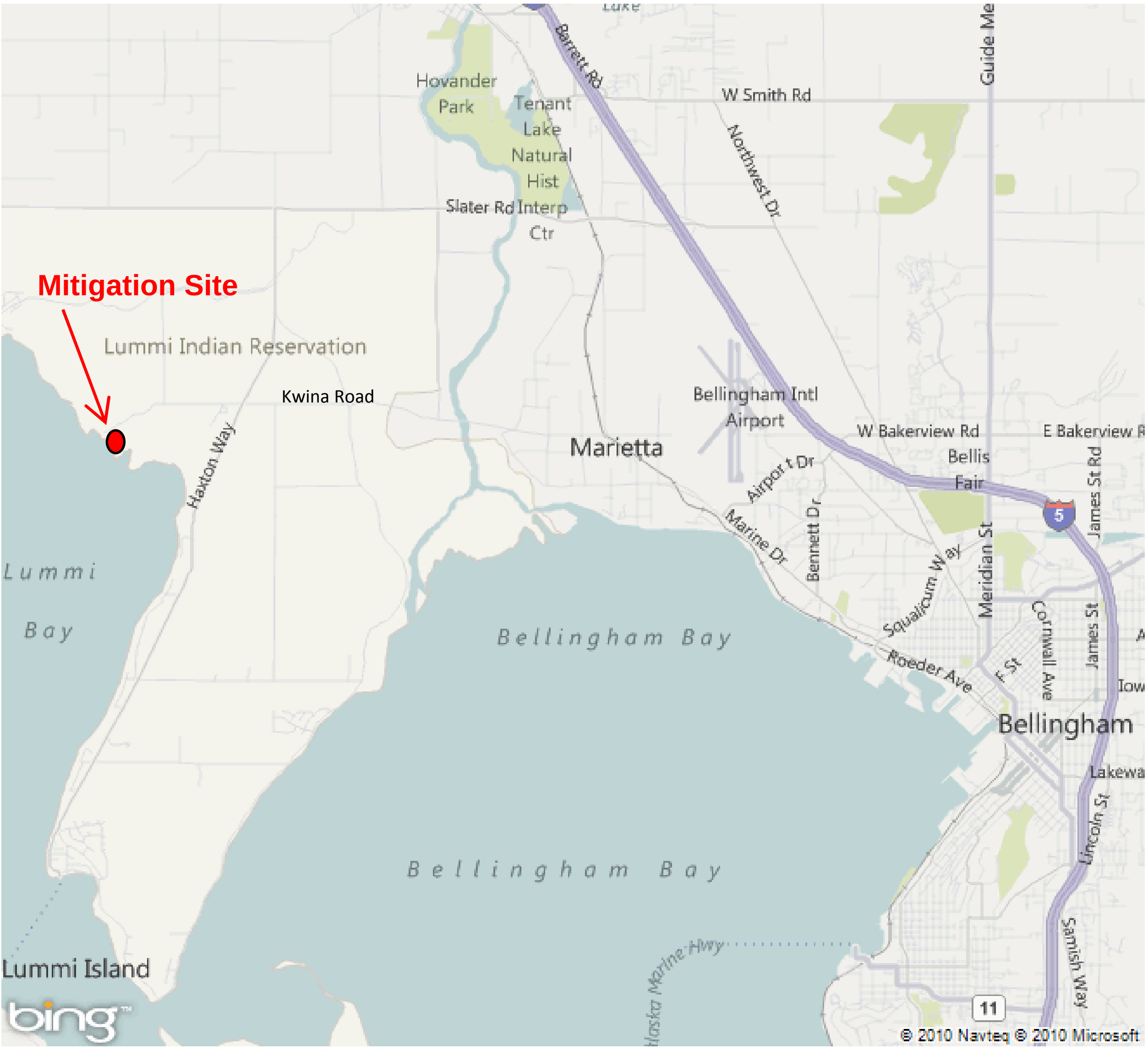


Figure 4.1. Vicinity map of Silver Reef Casino Wetland Mitigation Site

Figure 4.2. Aerial photograph showing the mitigation site.

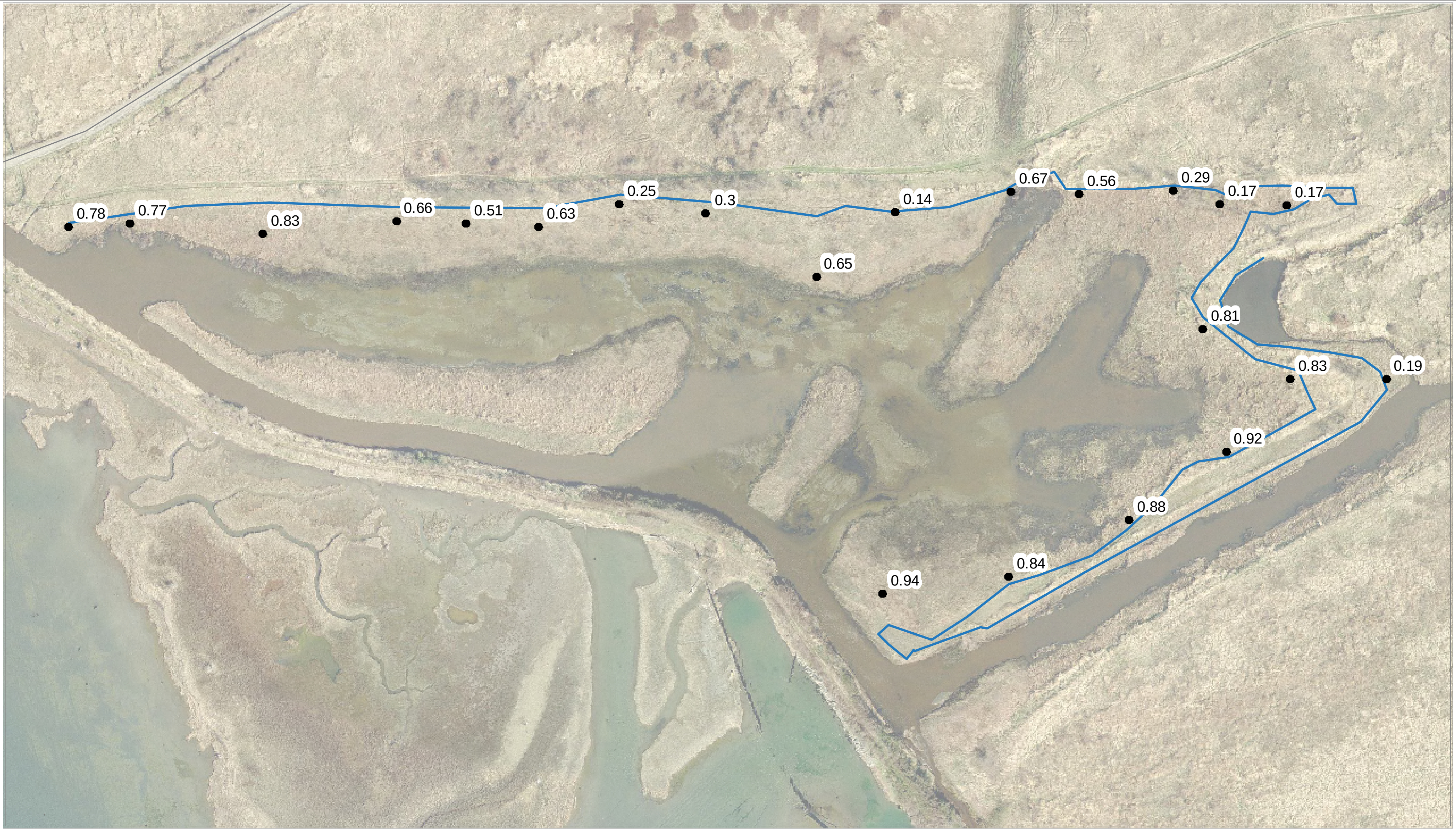
Conclusions

The majority of the Year 10 Performance Standards are being satisfied by the Silver Reef Casino Mitigation Site.

Recommended Actions for the Mitigation Site

In the ten years since the mitigation plan was installed (it was completed in August 2001), the site has developed into a thriving estuarine ecosystem with a mosaic of high saltmarsh, low saltmarsh, and mudflat habitats, as well as salt-sensitive wetland areas and limited upland areas. Consequently, the mitigation site provides significant uplift of the functions previously provided by the wetland areas impacted by construction of the Silver Reef Hotel-Casino complex, and the limited wetland areas on the mitigation site prior to installation of the mitigation plan. Because the mitigation site is achieving the overall goals of the mitigation plan, we recommend that the permitting agencies release the site as completed.

Appendix A—Maps/Figures



Casino Mitigation Site Salinity and Inundation (01/07/2011)

0 100 200
Feet

Figure 1

Salinity(PPT)

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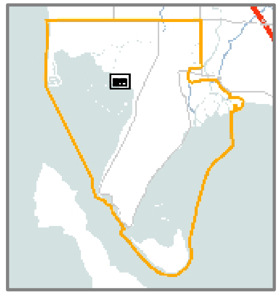
Extent of Inundation

The inundation on the islands was not delineated.

Cartography: Gerry Gabrisch geraldg@lummi-nsn.gov
Datum, Projection, Coordinate System: NAD83 UTM 10 N



Casino Mitigation Site 2010

0 100 200 400

Feet

Figure 2

N

Casino Mitigation Sampling Plots

Salinity Sampling 07/13/2010 *(Salinity in ppt)*

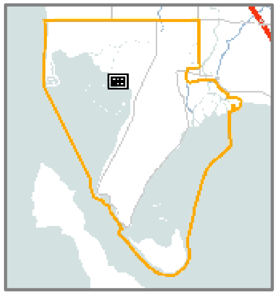
Salinity Sampling 06/18/2010

Debris Waterline 02/22/ 2010

Vegetation Boundary 07/31/2009

Casino Mitigation Site Inundation (12/21/2010)

Cartography: Gerry Gabrisch geraldg@lummi-nsn.gov
Datum, Projection, Coordinate System: NAD83 UTM 10 N



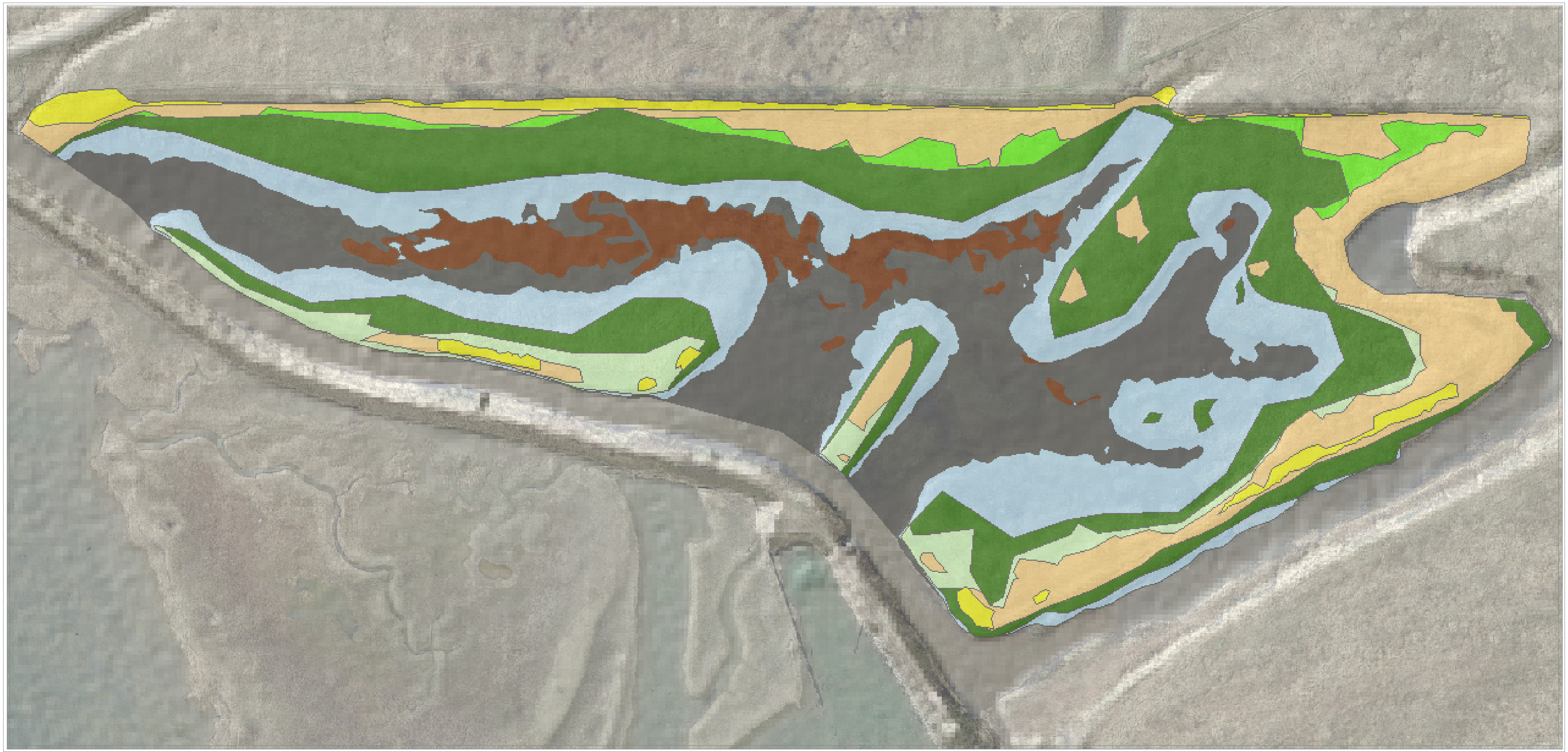
Extent of Inundation

0 100 200
Feet

N

Figure 3

The inundation on the islands was not delineated.



Casino Mitigation Site
Vegetation Communities
6/5/2011 - 8/1/2011

	acres
Upland	0.57
High Marsh (mixed/Baltic rush/Pacific silverweed)	0.76
High Marsh (Pacific silverweed/bent grass community)	0.50
High Marsh (Baltic rush/Pacific silverweed community)	4.66
Low Marsh (alkali bulrush/pickle weed community)	4.39
Vegetated Mud Flat	1.13
Mud Flat	3.90
Non-Tidal Wetland	2.78

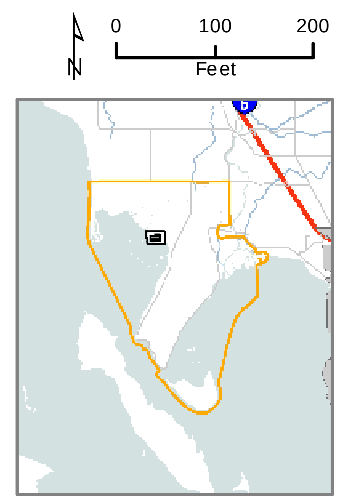
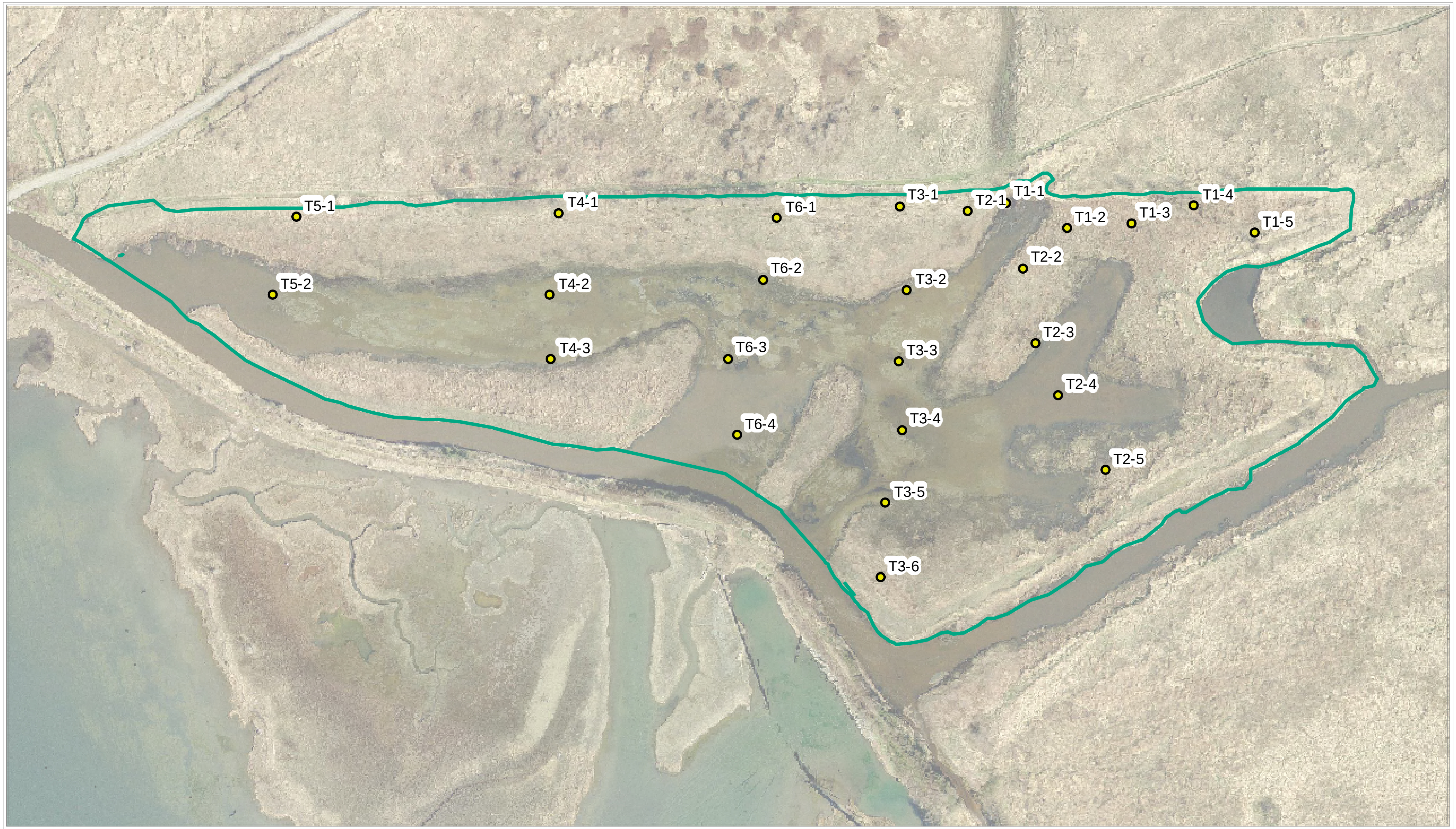


Figure 4



Casino Mitigation Site

(01/07/2011)

Casino Mitigation Bank Project Boundary

Casino Mitigation Vegetation Plots

0 100 200
Feet

N

Figure 5

Cartography: Gerry Gabrisch geraldg@lummi-nsn.gov
Datum, Projection, Coordinate System: NAD83 UTM 10 N

Lummi Nation GIS Department makes no claim as to the accuracy, completeness, or content of any data contained herein.
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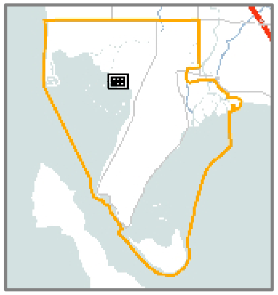

Casino Mitigation Site
Invasive Plant Species

(06/05/2011)

Casino Mitigation Bank Project Boundary

Area with Invasive Species

Small Area of Invasive Species (<16 ft. sq.)

Total Area of Occurrence of Invasive Species = 0.87 acres

Total Coverage of Invasive Species = 0.58 acres*

*adjusted for actual percent invasive cover, which varied from 5% to 100% in individual mapped units.

0 100 200

Feet

N

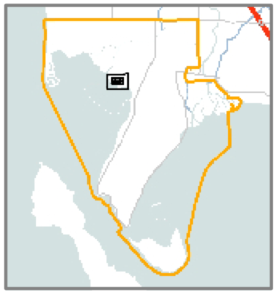

Figure 6

Appendix B—Photos

Appendix B—Site Photos

Overviews

Photo 1—Southwest end of the mitigation site (in the distant center), looking east along the slough from the seawall on July 26, 2011.

Photo 2—Overview of the mitigation site from the northwest corner, looking east/southeast on June 1, 2011. Note the transition from the high saltmarsh (dark green Baltic rush), to the low saltmarsh (lighter green alkali bulrush), to the mud flat

Appendix B—Site Photos

Transect 1

Photo 3—Transect 1, Plot 1, Looking South

Photo 4—Transect 1, Plot 2, Looking East

Photo 5—Transect 1, Plot 3, Looking SW

Photo 6—Transect 1, Plot 4, Looking East

Photo 7—Transect 1, Plot 5, Looking East

Photo 8—Transect 2, Plot 1, Looking SW

Photo 9—Transect 2, Plot 2, Looking NE

Photo 10—Transect 2, Plot 3, Looking NW

Photo 11—Transect 2, Plot 4, Looking West

Photo 12—Transect 2, Plot 5, Looking South

Photo 13—Transect 3, Plot 1, Looking South

Photo 14—Transect 3, Plot 2, Looking West

Photo 15—Transect 3, Plot 3, Looking North

Photo 16—Transect 3, Plot 4, Looking North

Photo 17—Transect 3, Plot 5, Looking North

Photo 18—Transect 3, Plot 6, Looking North

Photo 19—Transect 4, Plot 1, Looking West

Photo 20—Transect 4, Plot 2, Looking West

Photo 21—Transect 4, Plot 3, Looking North

Photo 22—Transect 5, Plot 1, Looking Southeast

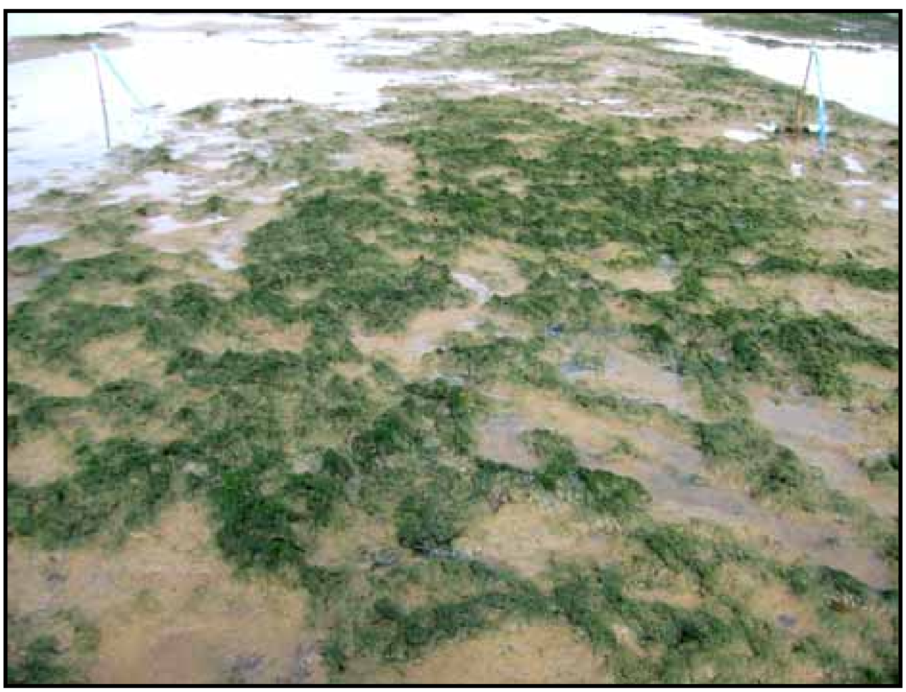

Photo 23—Transect 5, Plot 2, Looking West

Photo 24—Transect 6, Plot 1, Looking West

Photo 25—Transect 6, Plot 2, Looking East

Photo 26—Transect 6, Plot 3, Looking North

Photo 27—Transect 6, Plot 4, Looking North

Photo 28—Looking west perpendicular to Transect 6 at low saltmarsh alkali bulrush community and vegetated mud flat at half-tide

Photo 29—Low saltmarsh alkali bulrush/pickleweed community

Photo 30—Looking at transition from low saltmarsh alkali bulrush community on left, to high saltmarsh Baltic rush/Pacific silverweed community on right

Photo 31— High saltmarsh Baltic rush/Pacific silverweed community

Photo 32—Looking north across mud flat at alders along northern boundary of mitigation site

Photo 33—Shore birds foraging in flooded mud flat at half-tide

Appendix C—Methods

Appendix C—Methods

Contents:

Appendix C—Methods
Monitoring Schedule and Transects

The monitoring plan is fully described in the document: *Lummi Nation Casino Project: Wetland Compensation Site As-built Report and Monitoring Plan* (Sheldon & Associates, 2001). This appendix summarizes monitoring methods that are being used throughout the ten-year monitoring period. A total of five parameters were originally proposed to be assessed: sediment movement, hydrologic regime, salinity, vegetation, and wildlife use. Due to an inability to accurately collect the sediment data, that parameter is no longer tracked since no 'baseline' data was collected, and attempts to collect sediment data in subsequent years failed due to the methodology employed.

Monitoring Schedule

Frequency of monitoring and number of samples per monitoring event for hydrologic regime, salinity, vegetation, and wildlife use is summarized in Table C1 below.

Table C1. Monitoring Frequency and Sample Numbers by Parameter and Year

Parameter	Frequency of Sampling by Monitoring Year[a]										Number of Samples per Monitoring Event	Timing of Monitoring
	1	2	3	4	5	6	7	8	9	10		
Hydroperiod	M	S	B	B	B	B	B	B	B	B	20	Vary to sample at different tide heights
Salinity	M	A	A	N	A	N	A	N	N	A	Where monitoring stations are inundated	Vary to sample at different tide heights
Vegetation	A	A	A	A	A	A	A	A	A	A	125 subplots in 25 plots	July-August (growing season)
Wildlife	To be conducted whenever other parameters are monitored										General observations	With hydrologic regime monitoring - vary time of day

[a] Frequency of monitoring: A = annually, B = bi-annually (twice per year), M = monthly, N = none for that year, and S = six times per year (every 2 months)

Monitoring Transect Locations

Six transect lines were established in the mitigation area at the completion of construction - see Figure 5 in Appendix A. A total of 20 permanent monitoring stations for salinity, hydrology, and sediment were established in the mitigation site along the six transect lines. Locations were selected to represent the range of elevations within both the high and low marsh areas. The monitoring stations were marked with 5-foot lengths of 1.5-inch diameter PVC pipe, driven into the substrate to a depth of at least 10 inches. Each pipe was labeled with the transect and station number. The positions of the monitoring stations were located using GPS. In addition 25 permanent 5-meter square monitoring plots for vegetation were also established along the transects; refer to vegetation monitoring methods section below for details.

Appendix C—Methods
Hydroperiod and Salinity Monitoring

Hydroperiod

In order to provide information about tidal amplitude on the site, water depth is measured at the permanent stations, in the center of the 25 vegetation monitoring plots, and at other locations at a variety of tidal heights (see Figures 1 and 3 in Appendix A).

Salinity

Salinity was measured by using a Yellow Springs Instruments (YSI) 556 Multiprobe System according to methodologies specified in the *Quality Assurance Project Plan Lummi Nation Water Quality Monitoring Program Version 4.0.* (Water Resources Division Lummi Natural Resources Department, 2010). Measurements were made at the stations, vegetation plots on the transects, or at selected sites. Measurement sites were located using a hand-held GPS unit (Trimble GeoXT), and the information was downloaded into ArcMap10 GIS software. Horizontal accuracy of the Trimble GeoXT is +/- 2 feet with post-processing. For Year 10, staff from the Lummi Nation Natural Resources Department (LNR) measured salinity on January 7, 2011. For Year 9, staff from the Lummi Nation Natural Resources Department (LNR) measured salinity on June 18 and July 13, 2010 (see Figures 1 and 2 in Appendix A).

Vegetation Monitoring Plots

During the Year 1 monitoring event (October 2002), 25 permanent vegetation monitoring plots (each 5-meters square) were established along the six transects (see Figure 5 in Appendix A).

Table C2. Number of Vegetation Sampling Plots on Each Transect

Transect Number	Length of Transect (feet)	Number of Plots (5 x 5 m)
1	530	5
2	590	5
3	700	6
4	370	3
5	260	2
6	430	4
Total Number of Vegetation Plots		**25**

Locations of the 25 plots were randomly selected using the following method. An east-west oriented baseline was established along the north edge of the wetland mitigation site. From the baseline, a total of six transects were established. T1 was established at the east end of the mitigation site, approximately parallel to the baseline. The remaining five transects (T2 through T 6) were established perpendicular to the baseline, at random distances along the baseline. The first plot along each transect was located a random distance from the baseline. This distance was chosen from a random number table with the range limited from 5 meters (diameter of the plots) through 35 meters (maximum spacing). Subsequent plots were located a standard 35 meters distance apart along each transect. The plot center points were offset from the transect by a perpendicular distance chosen from a random number table with the range limited from 1 through 5 meters (maximum set to avoid potential for plot overlap with adjacent transects). The direction of offset from the transect was also randomly selected. The corners of the plots were marked with rebar.

Vegetation Species Presence and Aerial Cover

For each vegetation monitoring event, five 625 square centimeter subplots (25-centimeter x 25-centimeter) are sampled within each of the 25 plots, for a total of 125 subplots. The subplot locations are chosen from a random number table, with the range limited from 1 through 400 (maximum number of 25 cm x 25 cm squares in a 5-meter square plot), and a 25 cm x 25 cm square quadrant is used to mark the edges of the subplots during sampling. The cover class for each plant species present in the subplot is recorded according to Table C3 below. For Year 10, vegetation monitoring was conducted on July 26 and 27, 2011 by Frank Lawrence III and Monika Lange of Lummi Nation Natural Resources Department (LNR), and Stephanie Smith and Suzanne Anderson of Otak, Inc. (Otak).

Table C3. Vegetation Cover Classes

Cover Class	Percent Cover Range
0	Trace
1	0.5 – 5
2	6 – 25
3	26 – 50
4	51 – 75
5	76 – 95
6	96 – 100

Photopoints

To document conditions, photos were taken at each of the 25 vegetation monitoring plots – see Appendix B.

Vegetation Salt Tolerance

Salt tolerance of plant species observed onsite was determined by consulting various references, including Hutchinson (1991), Hruby (2004), and Plants Database (USDA, 2011) (see Appendix E References). Categories of salt tolerance are designated as: none, low, medium, and high. Species with high salt tolerance were generally designated as Low Salt Marsh species; those with medium salt tolerance were generally designated as High Salt Marsh species; and species with low or no tolerance were designated as Salt–Sensitive species.

Vegetation Communities

Due to the constructed topography of the mitigation site, there is a range in frequency and depth of tidal inundation and salinity, so a variety of habitats and vegetation communities have become established onsite as a consequence. At the request of Kristina Tong of the U.S. Army Corps of Engineers, eight communities/habitats were described and mapped: Mud Flat; Vegetated Mud Flat; Low Salt Marsh; three High Salt Marsh Communities; non-tidal wetland community; and upland (see Figure 4 in Appendix A, and wetland delineation report, Otak, 2011). Vegetation communities were defined by the dominant species as listed below. Points along the vegetation community edges were located using a hand-held GPS unit (Trimble GeoXT), and the information was downloaded into ArcMap10 GIS software. Horizontal accuracy of the Trimble GeoXT is +/- 2 feet with post-processing. Vegetation communities were mapped on August 11, 2010 by Frank Lawrence III and Monika Lange (LNR), and Stephanie Smith and Suzanne Anderson (Otak); on September 14 and 24, 2010 by Frank Lawrence III and Monika Lange (LNR); on June 1 and 2, 2011 by Stephanie Smith, Suzanne Anderson, Frank Lawrence III, and Monika Lange; and on July 27, 2011 by Monika Lange and Suzanne Anderson.

Mud Flat:

- areas without macrophytic vegetation – includes many areas with filamentous green algae.

Vegetated Mud Flat:

- areas with the aquatic species widgeongrass (*Ruppia maritima*).

Low Marsh (alkali bulrush/pickleweed community):

- alkali bulrush (*Scirpus maritimus*)
- pickleweed (*Salicornia viginica*)
- salt-grass (*Distichlis spicata*) (subdominant)

High Marsh (Baltic rush/Pacific silverweed community):

- Baltic rush (*Juncus balticus*)
- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)

High Marsh (Pacific silverweed/creeping bentgrass community):

- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)
- creeping bentgrass (*Agrostis stolonifera*)
- Baltic rush (*Juncus balticus*) (subdominant)

High Marsh (mixed Baltic rush/Pacific silverweed community):

- Baltic rush (*Juncus balticus*)
- Pacific silverweed (*Potentilla anserina* now called *Argentina anserina*)
- Lyngby's sedge (*Carex lyngbyei*) (subdominant)
- salt-grass (*Distichlis spicata*) (subdominant)
- creeping bentgrass (*Agrostis stolonifera*) (subdominant)

Non-tidal Wetland Area:

- delineated wetland areas dominated by hydrophytic, but non-salt-tolerant, herbaceous species, with some willow (*Salix* sp.) and alders (*Alnus rubra*) along the northern boundary of the site.

Uplands:

- delineated non-wetland areas, dominated by upland species

Non-native Invasive Plant Species

In order to determine percent aerial cover by non-native invasive species on the mitigation site, on June 2, 2011, Monika Lange (LNR) and Stephanie Smith (Otak) located and mapped patches of reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus armeniacus*). The patches were located using a hand-held GPS unit (Trimble GeoXT), and the information was downloaded into

ArcMap10 GIS software. Horizontal accuracy of the Trimble GeoXT is +/- 2 feet with post-processing. Patches of up to 16 square feet (4-foot by 4-foot square) were mapped as a point, and larger patches were recorded as a polygon (see Figure 6 in Appendix A). Invasive cover in the individual patches varied from 5 to 100 percent, and averaged 52 percent. The total square footage of invasive cover was adjusted to reflect the percent cover by invasive species in each patch.

Wildlife

Observations of wildlife were made and noted whenever the site was visited, and animals were identified to species level whenever possible. In addition, indicators of wildlife use of the site, such as prints, scat, nests, etc., were noted.

Appendix D—Data

Appendix D: Data

Contents:

Vegetation: Monitoring Plot Data

Table D1. Frequency of Occurrence of Selected Species in Subplots Years 1 through 10.

Scientific Name	Common Name	Number of Subplots in Which Plant Species Occurred									
		Year 1 (2001- 02)	Year 2 (2002-03)	Year 3 (2003-04)	Year 4 (2004-05)	Year 5 (2005-06)	Year 6 (2006-07)	Year 7 (2007-08)	Year 8 (2008-09)	Year 9 (2009-10)	Year 10 (2010-11)
Agropyron repens	quackgrass	26	18	16	22	27	28	3	17	17	12
*Agrostis stolonifera**	creeping bentgrass*	48	49	40	42	59	56	52	63	63	58
Alopecurus geniculatus	water foxtail	27	15	8	0	0	0	0	0	0	0
*Atriplex patula**	fat-hen saltbush*	6	9	18	13	5	0	3	0	0	0
Cirsium arvense	Canada thistle	2	2	1	0	0	2	5	1	0	1
*Cotula coronopifolia**	brass buttons*	0	0	0	2	3	0	1	6	0	1
*Distichlis spicata**	saltgrass*	0	0	4	6	10	10	29	23	24	17
Epilobium ciliatum	Watson's willwherb	1	0	3	2	1	1	6	2	7	2
Equisetum arvense	common horsetail	0	0	0	0	1	1	2	1	2	3
Holcus lanatus	velvet grass	6	6	9	0	4	6	7	7	13	3
*Juncus balticus**	Baltic rush*	2	6	10	14	17	29	32	38	38	42
*Juncus bufonius**	toad rush*	0	0	6	4	9	5	0	2	0	1
Lactuca sp.	lettuce	0	1	0	2	5	3	0	0	1	5
*Phalaris arundinacea**	reed canarygrass*	1	3	5	2	4	2	8	14	7	12
*Potentillia anserina**	Pacific silverweed*	0	0	1	1	10	13	20	27	32	36
*Salicornia virginica**	pickleweed*	0	0	2	3	7	10	6	6	9	4
*Scirpus americanus**	American threesquare*	0	2	1	0	3	10	8	11	15	9
*Scirpus maritimus**	alkalai bulrush*	10	13	18	22	26	25	27	30	30	34
*Spergularia salina**	saltmarsh sandspurry*	1	0	6	13	5	3	0	0	0	0
Trifolium pratense	red clover	21	23	26	9	3	6	9	3	5	5
Vicia sp.	vetch	1	1	5	3	11	7	18	19	8	21

*Salt-tolerant species

Vegetation: Monitoring Plot Data continued

The cover classes listed below in Table D3 apply to the following Table D3. Vegetation Plot Data Summary.

Table D2. Cover Classes Used for Vegetation Plot Monitoring.

Cover Class	Percent Cover Range
0	Trace
1	0.5 – 5
2	6 – 25
3	26 – 50
4	51 – 75
5	76 – 95
6	96 – 100

Vegetation: Monitoring Plot Data continued

Table D3. Vegetation Plot Data Summary: Transects 1 and 2

	Low Marsh/ High Marsh	Plot #	Subplot #	Agrostis stolonifera	Agropyron repens	Alnus rubra	Distichlis spicata	Eleocharis palustris	Epilobium ciliatum	Equisetum arvense	Holcus lanatus	Juncus balticus	Latuca sp.	Moss	Phalaris arundinacea	Phleum pratense	Potentilla anserina	Rumex crispus	Ruppia maritima	Salix sitchensis	Salicornia virginica	Scirpus americanus	Scirpus maritimus	Scirpus tabernae-montanii	Sonchus spp	Trifolium pratense	Trifolium repens	Vicia sp.	Algae	Mud Flat
Transect 1	LOW	1	1	3								2										2	2							
	LOW		2	1								2										3	2							
	LOW		3																			3								
	LOW		4																			2	2							
	LOW		5									1										2	3							
Transect 1	LOW	2	1	2			2					4					2					0								
	LOW		2				3					3					3													
	LOW		3				3					1					2													
	LOW		4	1			1					2					2				1	0	0							
	HIGH		5	0			3		0			3	2	2			3				1	1								
Transect 1	HIGH	3	1	2								4					3													
	HIGH		2	1	0							5		2			2											2		
	HIGH		3	0								4		3			3													
	HIGH		4	1								3					3						0							
	HIGH		5	0								4					3						0							
Transect 1	HIGH	4	1	1	0							3					2													
	HIGH		2	0								3					2													
	HIGH		3	0						0		3					2											0		
	HIGH		4	2								2					2													
	HIGH		5	2						0		0					3			5										
Transect 1	HIGH	5	1	4	2		0		0		2			2														0		
	HIGH		2	3	1	0					4			5																
	HIGH		3	3	3				0		3			2	0															
	HIGH		4	2	2				0		2			3			2													
	HIGH		5	4	3	1			0		2			4	0		2									0				
Transect 2	HIGH	1	1	5											0													0		
	HIGH		2	5							2																			
	HIGH		3	5							1				0													0		
	HIGH		4	4	1											2														
	HIGH		5	5													0													
Transect 2	HIGH	2	1	2			2															0			3	2		0		
	HIGH		2	2	0		2		0								3					0			3		0			
	HIGH		3	2	1													1				2			2	4	2	0		
	HIGH		4		1				0																3	2				
	HIGH		5	2							0						0					1			4	2				
Transect 2	HIGH	3	1	1								5					4					2								
	LOW		2	1								4					4					1	0		1					
	HIGH		3	1								5					4													
	LOW		4	3			1										2				2		2							
	HIGH		5	3													2				2	1	1							
Transect 2	LOW	4	1																										4	2
	LOW		2																										3	3
	LOW		3																										5	2
	LOW		4																										4	3
	LOW		5																										5	2
Transect 2	HIGH	5	1	4								3																		
	HIGH		2	5																			0							
	HIGH		3	4								2																		
	HIGH		4	5			2																							
	HIGH		5	3			4					2																		

Table D3. Vegetation Plot Data Summary continued: Transects 3 and 4

	Low Marsh/ High Marsh	Plot #	Subplot #	Agrostis stolonifera	Agropyron repens	Alnus rubra	Distichlis spicata	Eleocharis palustris	Epilobium ciliatum	Equisetum arvense	Holcus lanatus	Juncus balticus	Latuca sp.	Moss	Phalaris arundinacea	Phleum pratense	Potentilla anserina	Rumex crispus	Ruppia maritima	Salix sitchensis	Salicornia virginica	Scirpus americanus	Scirpus maritimus	Scirpus tabernae-montanii	Sonchus spp	Trifolium pratense	Trifolium repens	Vicia sp.	Algae	Mud Flat
Transect 3	HIGH	1	1	4	3																									
	HIGH		2	3	4																									
	HIGH		3	5																										
	HIGH		4	4	2																									
	HIGH		5	2											5															
Transect 3	LOW	2	1	1			2	2															2	2						4
	LOW		2					2															4							3
	LOW		3																				3							5
	LOW		4																				4							4
	LOW		5																				3							5
Transect 3	LOW	3	1																										6	
	LOW		2																										5	1
	LOW		3																										6	
	LOW		4																										6	
	LOW		5																										6	1
Transect 3	LOW	4	1																										5	1
	LOW		2																				1						5	2
	LOW		3																										5	1
	LOW		4																										5	1
	LOW		5																										5	1
Transect 3	LOW	5	1				4														0		1							3
	LOW		2				4														4		1							3
	LOW		3				3														3		1							5
	LOW		4				3														3		1							4
	LOW		5				3														3		1							3
Transect 3	HIGH	6	1	3			3					3					1						1							
	HIGH		2	3								3																		
	HIGH		3	3			1					5													0					
	HIGH		4	1								4					2						0		2					
	HIGH		5	2			2					5																		
Transect 4	HIGH	1	1	5								1					5													
	HIGH		2	1								4					4													
	HIGH		3	1								3					3													
	HIGH		4									3			2		3													
	HIGH		5	3								4					3											0		
	LOW	2	1																5										5	2
	LOW		2																2										2	5
	LOW		3																5										5	1
	LOW		4																4										4	2
	LOW		5																4										5	1
	LOW	3	1																										5	1
	LOW		2				3																						4	3
	LOW		3				6																						1	1
	LOW		4				5																						1	1
	LOW		5				4																						2	1

Table D3. Vegetation Plot Data Summary continued: Transects 5 and 6; and Totals

	Low Marsh/ High Marsh	Plot #	Subplot #	Agrostis stolonifera	Agropyron repens	Alnus rubra	Distichlis spicata	Eleocharis palustris	Epilobium ciliatum	Equisetum arvense	Holcus lanatus	Juncus balticus	Latuca sp.	Moss	Phalaris arundinacea	Phleum pratense	Potentilla anserina	Rumex crispus	Ruppia maritima	Salix sitchensis	Salicornia virginica	Scirpus americanus	Scirpus maritimus	Scirpus tabernae-montanii	Sonchus spp	Trifolium pratense	Trifolium repens	Vicia sp.	Algae	Mud Flat
Transect 5	HIGH	1	1								0	4											0		3					
	HIGH		2	2							0	4													4					
	HIGH		3	3	1						1	3																		
	HIGH		4	3	2						0																			
	HIGH		5	2	2						0	5																		
	LOW	2	1																										5	2
	LOW		2																										5	2
	LOW		3																										3	3
	LOW		4																										5	2
	LOW		5																										5	2
Transect 6	HIGH	1	1	5																										
	HIGH		2	5																										
	HIGH		3	5											3															
	HIGH		4	5																										
	HIGH		5	5																										
	LOW	2	1																				4						1	5
	LOW		2																				3						2	6
	LOW		3																				3						2	5
	LOW		4																				4						2	5
	LOW		5																				4						2	5
	LOW	3	1																										2	4
	LOW		2																										4	2
	LOW		3																										5	1
	LOW		4																										4	3
	LOW		5																										2	5
	LOW	4	1																										5	1
	LOW		2																										5	1
	LOW		3																										5	2
	LOW		4																										4	2
	LOW		5																										6	
	Average cover when present			3	1.6	1	3	2.0	0	0.0	1.3	3.2	2.0	2.9	1.4	2.0	2.5	1.0	4.0	5.0	2.1	1.3	1.8	2.0	2.5	2.0	1.0	0.3	4.1	2.6
	Average cover all plots			1.36	0.22	0.01	0.53	0.03	0.00	0.00	0.14	0.97	0.02	0.18	0.08	0.02	0.65	0.01	0.16	0.04	0.15	0.16	0.42	0.02	0.20	0.08	0.02	0.02	1.46	1.08
	# of sub-plots species occurred			63	17	2	24	2	7	2	13	38	1	8	7	1	32	1	5	1	9	15	30	1	10	5	2	8	45	51
	% of sub-plots species occurred			50.4	13.6	1.6	19.2	1.6	5.6	1.6	10.4	30.4	0.8	6.4	5.6	0.8	25.6	0.8	4	0.8	7.2	12	24	0.8	8	4	1.6	6.4	36	40.8
	# plots with cover of 0			5	3	1	1	0	7	2	5	1	0	0	4	0	2	0	0	0	1	4	7	0	1	1	1	7	0	0
	# plots with cover of 1			12	5	1	3	0	0	0	2	3	0	0	0	0	1	1	0	0	2	4	8	0	1	0	0	0	3	15
	# plots with cover of 2			13	5	0	6	2	0	0	4	6	1	4	1	1	13	0	1	0	2	5	5	1	2	3	1	1	8	13
	# plots with cover of 3			13	3	0	8	0	0	0	1	12	0	2	1	0	11	0	0	0	3	2	5	0	4	0	0	0	2	9
	# plots with cover of 4			7	1	0	4	0	0	0	1	10	0	1	0	0	4	0	2	0	1	0	5	0	2	1	0	0	7	4
	# plots with cover of 5			13	0	0	1	0	0	0	0	6	0	1	1	0	1	0	2	1	0	0	0	0	0	0	0	0	20	9
	# plots with cover of 6			0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1

Unhanss900 Kathy
Customer Site

2011
~~2008~~ Silver Reef Casino Mitigation Site Monitoring

Date: 7/26/11

Sampling Team: SS, SA, FL, ML

100% cover by Alder rooted outside plot

Transect Number: 1

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	~~Plot 6~~
Subplot 1	19 JUBAL-70 AG-5 SCAM-~~20~~10 DETRITUS-30	64 SCAM-5 SCMA-<5 JUBAL-50 POAN-25 AG-5 WHT TRIFOLIUM-<5 DETRITUS-~~80~~90	54 JUBAL-95 POAN-40 DETRITUS-50 WHT TRIFOLIUM-5 SMALL VI-5 MOSS-10 AG-5 EPICIL-TRACE	55 JUBAL-~~40~~45 AG-5 POAN-5 CALY-5 EQAR-5 ~~BARE GROUND~~ DETRITUS-90	4 PHAR-5 ALRU-10 VI-5 POAN-10 AGRO-5 HOLA-20 JUBAL-20 MOSS-75%	← small vetch
Subplot 2	86 JUBAL-40 SCAM-60 POAN-5 DETRITUS-15	126 JUBAL-50 POAN-60 AG-5 MOSS-TRACE DETRITUS-95	105 SCMA-TR JUBAL-80 POAN-40 AG-5 MOSS-80 DETRITUS-75	164 JUBAL-90 POAN-10 DETRITUS-95	128 VI-40 (small) EPICIL-TRACE TRIF (white)-<5 AGRO-10 HOLA-30 AG-30 MOSS-75	← small vetch
Subplot 3	216 SCMA-60 DETRITUS-20	120 AG-30 JUBAL-35 POAN-40 SCMA-<5 DETRITUS 90	235 JUBAL-90 POAN-60 DETRITUS-80 ~~WHT TRIF~~	172 SASI-100 JUBAL-30 POAN-40 DETRITUS-95	130 VI-20 AGRO-40 POAN-5 HOLA-25 AG-20 MOSS-40	← small vetch
Subplot 4	350 SCMA-~~50~~45 DETRITUS-60	191 JUBAL-60 POAN-80 AG-20 POA-TRACE DETRITUS-90	276 JUBAL-75 POAN-45 DETRITUS-90 AG-5 SCMA-<5	218 AG-5 SASI-100 JUBAL-25 POAN-35 DETRITUS-95 EQAR-TR	230 PHAR-50 VI-50 AG-30 MOSS-25	
Subplot 5	265 SCMA-40 SCAM-40 JUBAL-<5 DETRITUS-25	259 JUBAL-40 POAN-75 SCMA-5 AG-10 DETRITUS-75	270 JUBAL-70 POAN-40 SCMA-<5 DETRITUS-70 MOSS-5	295 JUBAL-80 POAN-30 DETRITUS-80 EQAR-5 AG-~~TRACE~~ 5 CALY-TRACE	295 MOSS-10 VI-5 AG-5 PHAR-50 Dead RCG = 90%	
~~Subplot 6~~				20% cover by ALRU overhanging plot but rooted outside		

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AGRO – Agropyron "quackgrass"
ALOP – Aleopecurus spp "water foxtail"
AG – Agrostis gigantica "redtop"
AL – Algae
COCO – Cotula coronopifolia "brass buttons"
CL – Thistle spp
DECE – Deschampia cespitosa "tufted hairgrass"
DISP – Distichlis spicata "saltgrass
EPAN – Epilobeum angustifolum
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HOLA – Holcus lanatus "velvet grass"
JUBAL – Juncus balticus
JUBU – Juncus bufonius
JUEF – Juncus effuses

LA – Lactuca spp
LOMU – Lolium spp "Rye"
POAN – Potentilla anserine - silverweed
PHAR – Phalarus arundinacea
MO - Moss
MU – Mud
RUMEX – Rumex spp
SCAM – Scirpus americanus "American threesquare"
SCMA – Scirpus maritumus "seacoast bulrush"
SPER – Spergularia spp "sandspurry"
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CA – Thistle Cirsium arvense

SASI - SALIX SITCHEN

0=Trace, 1=0.5-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96+

ALRU - Alnus rubra
EQAR - EQUISETUM ARVENSE
EPICIL - Epilobium Ciliatum
CALY - CAREX LYNGBEI

2011
~~2009~~ **Silver Reef Casino Mitigation Site Monitoring** **Date:** 7/26/11
Sampling Team: SS, SA, FL, ML

Transect Number: 2

RUCR- Rumex Crispus
~~Spreatus~~

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	~~Plot 6~~
Subplot 1	150 AG-75 VI-5 (small) AGRO-5 Poa-5 Detritus-95	87 Red Clover-75 LA-10 RUCR-<5 VI- (small) AG-40 SCAM-<5 Detritus-80	111 POAN-70 ~~Scam~~ JUBAL-50 SCAM-5 SCMA-<5 DETRITUS-75	120 Scum on mud only	162 AG-90 SCMA-10 Detritus-10	
Subplot 2	211 VI-7 (big) AG-65 AGRO-10 VI-<5 (small) Detritus-95	171 LA-15 Red clover-70 AG-25 POAN-<5 VI-10 (small) Wht clover-10 Detritus-90	150 JUBAL-60 POAN-50 AG-5 SCMA-<5 SCAM-TRACE Detritus-70	221 Scum on Mud only	161 AG-10 DISP-90 Detritus-95	
Subplot 3	373 RCG-20 VI-10 (small) AG-60 Detritus-90	260 LA-15 JUBAL-75 POAN-5 VI-15 (small) Red Clover-50 AG-5 Moss-10 Detritus-50	137 JUBAL-15 POAN-70 SCAM-5 SCMA-20 AG-<5 POA-5 Detritus-5	187 Scum on mud & <5% fillamentous algae	206 AG-85 AGRO-5 DISP-10 Detritus-95	
Subplot 4	353 VI-15 (big) RCG-<5 AG-90 Detritus-95	314 LA-40 POAN-40 Red Clover-40 JUBAL-25 AG-20 white clover-10 MOSS-20 Detritus-5	233 SCMA-10 POAN-45 AG-40 SAVI-5 Detritus-40	246 Scum on mud & Trace of fillamentous algae	302 JUBAL-TRACE AG-30 DISP-70 Detritus-95	
Subplot 5	263 VI-55 (big) AG-85 AGRO-TRACE Detritus-95	366 LA-30 VI-95 (small) CA-5 MOSS-50 AG-20 Red clover-20 White clover-5 AGRO-5 Detritus-30	304 SAVI-15 SCAM-10 SCMA-10 POAN-50 AG-15 JUBU-TRACE Detritus-30	378 Scum on mud only	394 JUBAL-90 DISP-10 AG-10 Detritus-95	
~~Subplot 6~~						

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2011

~~2005~~ Silver Reef Casino Mitigation Site Monitoring **Date:** 7/26/11

Sampling Team: SS, SA, FL, ML

Transect Number: 3

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Subplot 1	186 RCG-5 VI-5 (small) AG-75 AGRO-10 detritus-80	128 POAN-25 JUBAL-60 Hard stem-<5 DISP-TRACE AG-TRACE Detritus-90	126 60% fill algae mud w/scum	110 mud w/scum & 40% fillamentous algae	114 fillamentous algae 95% SCMA-TRACE	103 SCMA-<5 JUBAL-80 AG-5 DISP-5 DETRITUS-95
Subplot 2	181 AG-95 detritus-90	199 POAN-20 JUBAL-60 SCMA-<5 ELPA-TRACE DISP-30 Detritus-90	178 brass button-5% fill algae-30% mud w/scum	302 mud w/scum 40% algae (fill) SCMA-TRACE	107 DISP-20 SCMA-35 Fillamentous algae <5 Mud w/scum-80 Detritus-10	168 POAN-10 SCMA-10 JUBAL-60 DISP-<5 AG-<5 DETRITUS-95
Subplot 3	235 RCG-95 AG-TRACE detritus-30	276 SCMA-70 mud-40 Detritus-60	250 70% fill. algae mud w/scum	184 mud w/scum & 40% fill. algae	181 DISP-20 SCMA-30 detritus-10 mud w/scum-95	248 DISP-10 SCMA-5 AG-10 JUBAL-50 DETRITUS-80
Subplot 4	343 AG-90 VI-5 (small) AGRO-10 detritus-90	295 ~~[illegible]~~ SCMA-70 mud-~~40~~ 30 detritus-70	312 ~~30~~ 40% fill algae mud w/scum	244 mud w/scum 40% fill algae brass button 5%	361 DISP-90 SAVI-15 Detritus-80	253 POAN-25 JUBAL-60 SCMA-10 DISP-5 AG-5 Detritus-40
Subplot 5	356 RCG-80 AG-10 detritus-70	282 ~~[illegible]~~ SCMA-60 mud-~~40~~ 20 detritus-80	287 10% fill. algae mud w/scum	196 mud w/scum 40% fill. algae	373 SAVI-40 DISP-35 Detritus-20 MUD-~~10~~ 40	236 POAN-30 JUBAL-60 AG-10 Detritus-80
~~Subplot 6~~						

ELPA = SPIKERUSH = Eleocharis palustris

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2011
~~2008~~ Silver Reef Casino Mitigation Site Monitoring

Date: 7/27/11

Sampling Team: SS & SA

Transect Number: 4

	Plot 1	Plot 2	Plot 3	~~Plot 4~~	~~Plot 5~~	~~Plot 6~~
Subplot 1	46 POAN-40 ~~AG~~-50 90% cover by alder overhanging detritus-95	125 widgeon-Trace mud w/scum	34 fill. algae-75 mud w/scum			
Subplot 2	112 RCG-80 AG-20 POAN-30 JUBAL-20 detritus-90	24 fill algae-30% mud w/scum	50 45-fill. algae widgeon <5 mud w/scum			
Subplot 3	144 RCG-95 JUBAL-15 detritus-10	128 mud w/ scum	251 fill algae-40 DISP-50 mud-15 detritus-60			
Subplot 4	212 POAN-45 JUBAL-70 AG-Trace detritus-95	311 Widgeon-Trace fill algae-Trace mud w/scum	263 DISP-80 SCMA-Trace mud-90 detritus-5			
Subplot 5	327 POAN-80 JUBAL-50 AG-Trace detritus-95	359 widgeon-Trace mud w/scum	309 SCMA-10 DISP-90 mud-80 detritus-5			
~~Subplot 6~~						

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0=Trace, 1=0.5-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96+

~~2007~~ 2011 Silver Reef Casino Mitigation Site Monitoring

Date: 7/27/11

Sampling Team: SS, SA

Transect Number: 5

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Subplot 1	17 Sonchus - 25 VI - 15 (big) JUBAL - 75 CALY - TRACE Detritus - 90	18 30% fill. algae ~~seaw~~ mud w/ scum		Plot 1 - wrack line @ northern end of plot (near subplot 1) & in subplot 2		
Subplot 2	24 JUBAL - 55 Sonchus - 10 VI - 5 (small) AGRO - <5 Detritus - 95	64 90% fill algae mud w/ scum				
Subplot 3	87 JUBAL - 80 Sonchus - 50 AG - 10 Detritus - 90	67 75% fill. algae mud w/ scum				
Subplot 4	255 JUBAL - 20 AG - 40 AGRO - 40 Sonchus - 10 VI - TR (big) detritus - 80 White clover - TRACE	103 40% fill. algae mud w/ scum				
Subplot 5	305 JUBAL - 95 AG - <5 VI - <5 (big) detritus - 95	270 20% fill. algae mud w/ scum				
Subplot 6						

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CALY = Carex Lyngbei

2011
~~2007~~ **Silver Reef Casino Mitigation Site Monitoring** **Date:** 7/27/11
Sampling Team: SS & SA

Transect Number: 6

	Plot 1	Plot 2	Plot 3	Plot 4	~~Plot 5~~	~~Plot 6~~
Subplot 1	26 RCG-15 AG-40 detritus-95	104 widgeon <5 SCMA-20 fill algae-60 mud-30 detritus-10	11 fill algae-5 mud w/scum 95	173 60 fill algae mud w/scum 40		Plot 1 has wrack line running across N section
Subplot 2	72 RCG-90 AG-Trace detritus-25	144 widgeon-Trace SCMA-25 fill algae-50 mud-40 detritus-10	207 mud w/scum 100	313 fill. algae 85 mud w/scum 15		
Subplot 3	307 AG-95 POAN-10 Detritus-90	153 SCMA-45 fill algae-50 mud-40 detritus-5	300 fill algae-10 mud w/scum 90	221 90% fill. algae mud w/scum 10		
Subplot 4	370 AG-95 detritus-85	289 SCMA-40 fill. algae-15 mud-65 detritus-5	342 fill algae-10 mud w/scum 90	321 fill algae-Trace mud w/scum 100		
Subplot 5	393 AG-95 detritus-90	343 SCMA-30 fill. algae-60 detritus -~~25~~ mud-55	379 mud w/scum 100	283 fill algae-50 mud w/scum		
~~Subplot 6~~						

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0=Trace, 1=0.5-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96+

Wildlife Observations

Table D4. Wildlife Species Observed On or Over the Mitigation Site

Scientific Name	Common Name	Frequency of Observation
Birds		
Agelaius phoeniceus	Red-winged Blackbird	Occasional, observed in 2011
Anas clypeata	Northern Shoveler	Occasional
Anas platyrhynchos	Mallard	Frequent, observed in 2011
Ardea herodias	Great Blue Heron	Frequent, observed in 2011
Bombycilla cedrorum	Cedar Waxwing	Occasional
Branta canadensis	Canada goose	Frequent, observed in 2011
Bucephala albeola	Bufflehead	Occasional
Buteo jamaicensis	Red-tailed Hawk	Frequent; observed in 2011
Calidris alpina	Dunlin	Occasional
Calidris melanotos	Pectoral Sandpiper	Frequent; observed in 2011
Calidris minutilla	Least Sandpiper	Occasional
Cathartes aura	Turkey Vulture	Occasional
Ceryle alcyon	Belted Kingfisher	Frequent, observed in 2011
Charadrius vociferus	Killdeer	Frequent, observed in 2011
Circus cyaneus	Northern Harrier	Frequent; observed in 2011
Cistothorus palustris	Marsh Wren	Occasional, observed in 2011
Corvus brachyrhynchos	American Crow	Frequent; observed in 2011
Corvus corax	Common Raven	Occasional, observed in 2011
Empidonax traillii	Willow Flycatcher	Occasional, observed in 2011
Falco peregrinus	Peregrine Falcon	Occasional
Geothlypis trichas	Common Yellowthroat	Occasional, observed in 2011
Haliaeetus leucocephalus	Bald Eagle	Occasional, observed flying over in 2011
Hirundo rustica	Barn Swallow	Frequent, observed in 2011
Larus sp.	Gulls	Frequent, observed in 2011
Limnodromus scolopaceus	Long-billed Dowitcher	Frequent, observed in 2011
Tachycineta thalassina	Violet-Green Swallow	Frequent, observed in 2011
Tringa flavipes	Lesser Yellowlegs	Occasional
Tyto alba	Barn Owl	Infrequent, observed (dead) in 2011
Mammals		
Canis latrans	Coyote	Occasional, observed in 2011
Castor canadensis	Beaver	Occasional
Lutra canadensis	River Otter	Occasional, tracks and scat observed in 2011
Micotus sp.	Field Mice	Occasional, observed (dead) in 2011
Odocoileus hemionus	Black-tailed deer	Occasional; sighted and tracks and bedding areas observed in 2011
Ondatra zibethica	Muskrat	Occasional
Procyon lotor	Raccoon	Occasional, tracks observed in 2011

Table D4. Wildlife Species Observed On or Over the Mitigation Site continued

Scientific Name	Common Name	Frequency of Observation
Fish		
Gasterosteus aculeatus	Three-spine Stickleback	Frequent, observed in 2011
Oncorhynchus spp	Juvenile Salmonids	Occasional; observed schooling at outside tidegate
Invertebrates		
Haminaea vesicula	Bubble Shell Snail	Very abundant during late summer visits
Unknown	Amphipods and Insects	Frequent, including: boatmen, amphipods, soldier beetles, and spiders
Unknown	Crab	Infrequent
Unknown	Shrimp	Frequent

Appendix E—References

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References

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